

# **Medicare Data for the Health Indicators Warehouse: A Methodological Overview**

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## **Introduction**

Federal policymakers and health researchers have long recognized that the amount and quality of the health care services that Medicare beneficiaries receive vary substantially across different regions of the United States. Much of that variation does not appear to be caused by differences in beneficiaries' health, and one widely-publicized estimate asserted that as much as 30 percent of Medicare expenditures may be unnecessary.<sup>1</sup>

The Center for Strategic Planning's Office of Policy (OP) within the Centers for Medicare & Medicaid Services (CMS) has developed a new data set for the Health Indicators Warehouse (HIW) to support further analysis of this important issue. This data set is based primarily on 2008 information from CMS's Chronic Condition Data Warehouse (CCW), which contains 100 percent of Medicare claims for beneficiaries who are enrolled in the fee-for-service (FFS) program as well as enrollment and eligibility data. The HIW data set has information on the demographics, service utilization, and prevalence of certain chronic conditions for Medicare beneficiaries in different parts of the country. We also incorporated a variety of quality indicators that can be used to analyze relationships between Medicare utilization and quality of care.

This paper summarizes the methodology that OP used to develop the HIW data set. This overview is divided into the following five sections:

1. Study population
2. Geographic variables
3. Disease variables
4. Utilization measures
5. Quality measures

## **1. Study Population**

Our primary goal in developing the HIW data set was to allow users to analyze differences in health care utilization, prevalence of chronic conditions, and quality of care for Medicare beneficiaries living in different parts of the United States. We excluded certain categories of Medicare beneficiaries from our calculations to make those comparisons as meaningful as possible.

First, we did not include beneficiaries who were enrolled at any point during the year in a Medicare Advantage (MA) plan. (There were 11.0 million beneficiaries in MA plans in 2008,

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<sup>1</sup> John Wennberg et al. *Tracking the Care of Patients with Severe Chronic Illness – The Dartmouth Atlas of Health Care 2008*, The Dartmouth Institute for Health Policy and Clinical Practice.

about 23 percent of the overall total.) CMS does not currently collect claims information for MA beneficiaries, so it is not possible to analyze their health care utilization.

Second, we did not include beneficiaries who first became eligible for Medicare after January of the calendar year (2.3 million) and thus have less than a full year of spending in our data.

Third, we did not include beneficiaries who were enrolled only in Part A or Part B (3.6 million). Since those beneficiaries are enrolled in only one part of Medicare, their utilization patterns cannot be compared directly to those for beneficiaries that are enrolled in both Part A and Part B.

Finally, we did not include beneficiaries who were under the age of 65 and received Medicare because they were either disabled (4.9 million) or had end-stage renal disease (ESRD, 175,000).<sup>2</sup> We excluded those beneficiaries because they differ in numerous respects from the over-65 population and could have different health service needs that are difficult to adjust for across geographic regions.

As shown below in Table 1, the study population for the HIW data set has 25.8 million Medicare beneficiaries, comprising about 54 percent of the national total. We would like to note that our study population does include beneficiaries who died during the calendar year (about 5 percent of the study population) as long as they were not excluded for one of the reasons outlined above.

	<u>Number</u>	<u>Percent</u>
Total Medicare beneficiaries in 2008	47,850,425	100.0
Beneficiaries excluded from our analysis:		
Any enrollment in MA	11,010,040	23.0
First eligible after January 2008	2,344,071	4.9
Part A only or Part B only	3,572,468	7.5
Disabled	4,916,123	10.3
ESRD	174,803	0.4
Total excluded beneficiaries	22,017,505	46.0
Study population for the HIW data set	25,832,920	54.0
Beneficiaries in study population that died during 2008	1,365,882	5.3
<b>Note:</b> Components may not sum to totals because of rounding.		

<sup>2</sup> Beneficiaries that are age 65 or older and originally qualified for Medicare on the basis of disability or ESRD are included in our study population.

The HIW data set has the following demographic information, by geographic region, for the Medicare beneficiaries included in the study population:

- The number of beneficiaries
- Beneficiaries by gender
- Beneficiaries by race and ethnicity (using non-Hispanic white, African-American, Hispanic, Asian-American or Pacific Islander, American Indian, and other as the categories)
- Average age
- The percentage of beneficiaries that are eligible for full benefits under the Medicaid program
- The ratio of the average total risk score for beneficiaries in the region to the national average for our study population. We calculated risk scores using the hierarchical condition category model that CMS uses to risk-adjust payments to MA plans. A ratio that is greater than 1 indicates that the beneficiaries in the region are expected to have higher costs, on average, than the national average.

Table 2 provides demographic information at a national level for the study population.

<b>Table 2: Demographic Information for HIW Study Population</b>		
	<u>Number</u>	<u>Percent</u>
Total beneficiaries in study population (2008)	25,832,920	100.0
By gender:		
Female	14,953,519	57.9
Male	10,879,401	42.1
By race:		
White, non-Hispanic	21,829,671	84.5
African-American	1,876,307	7.3
Hispanic	1,285,537	5.0
Asian-American / Pacific Islander	552,432	2.1
American Indian	99,464	0.4
Other	189,509	0.7
Average age	76.5	
Percentage eligible for full Medicaid benefits		14.4

## **2. Geographic Variables**

After considering a variety of alternatives, we decided to use hospital referral regions (HRRs), individual states, and the United States as a whole as the geographic units of analysis in the HIW data set. HRRs were developed by the Dartmouth Atlas of Health Care to delineate regional health care markets in the United States. See Appendix 1 for a complete list of HRRs.

The Dartmouth Atlas constructed HRRs by grouping ZIP codes together based on the referral patterns for tertiary care for Medicare beneficiaries. HRRs also had to have a minimum overall population of 120,000, and the residents of each HRR had to receive at least 65 percent of their hospitalizations within the HRR. There are 306 HRRs in the United States, and their boundaries often cross state lines. For example, the HRR for Memphis, Tennessee, includes parts of eastern Arkansas and northern Mississippi.

We assigned Medicare utilization to HRRs (and states, for that matter) based on where beneficiaries live, rather than where they received care. However, HRRs are large enough to encompass most of the care received by beneficiaries, even if they obtain care in multiple localities or counties. (We analyzed Medicare expenditure data and found that 83 percent of Medicare expenditures in 2008 occurred in the same HRR where the beneficiary lived.) Furthermore, HRRs generally have populations that are large enough to generate stable averages for comparisons of utilization patterns, even for narrowly defined combinations of conditions and services.

## **3. Disease Variables**

The geographic variation in Medicare service use may be due, at least in part, to regional differences in the prevalence of particular diseases (or combinations of diseases). For example, Medicare spending in a particular area could be higher because the beneficiaries who live there are more likely to suffer from an expensive condition such as heart failure.

The CCW has flags that indicate if a beneficiary has one or more of 21 specific chronic conditions. We used those flags to generate disease-related variables for 12 particularly common (and expensive) conditions for the HIW data set:

- Acute myocardial infarction (heart attack)
- Atrial fibrillation
- Chronic kidney disease
- Chronic obstructive pulmonary disease
- Colorectal cancer
- Depression
- Diabetes
- Female breast cancer
- Heart failure
- Ischemic heart disease
- Lung cancer
- Prostate cancer

For each disease, we calculated two figures: (1) the *number* of beneficiaries that are in our study population, live within a particular region, and have the disease; and (2) the *percentage* of beneficiaries that are in our study population, live within a particular region, and have the disease.

Users of the HIW data set should keep in mind that the conditions listed above are not mutually exclusive – beneficiaries can (and often do) have more than one condition.

#### **4. Utilization Measures**

We created the HIW data set to analyze underlying differences in utilization among Medicare beneficiaries in different parts of the country. Those differences reflect variation in such factors as physicians' practice patterns and beneficiaries' ability and willingness to obtain care.

We used the claims-level data from the CCW to generate three different types of utilization measures for each geographic region:

- The *number of times* that the beneficiaries in our study population used a particular service, expressed in terms of usage per 1,000 beneficiaries. We calculated these figures across all beneficiaries in the study population, rather than just those beneficiaries who used that particular service. The metrics that we used to measure utilization varied by the type of service and are described in more detail below.
- The *number of beneficiaries* in our study population who used a particular service
- The *percentage of beneficiaries* in our study population who used a particular service

We generated these utilization measures for 17 major service categories. Those categories are listed below, grouped by the units of measurement that we used for each service:

- Number of admissions, number of days of care<sup>3</sup>
  - Inpatient acute care hospitals paid under the prospective payment system (PPS)
  - Critical access hospitals
  - Other inpatient hospital care<sup>4</sup>
  - Inpatient hospital care (use of any type of hospital listed above)
  - Long-term care hospitals (LTCHs)
  - Inpatient rehabilitation facilities (IRFs)
  - Skilled nursing facilities (SNFs)
  - Hospice
- Number of episodes, number of visits
  - Home health

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<sup>3</sup> Our calculations for all hospital-related and SNF services were based only on Medicare-covered days.

<sup>4</sup> This category includes hospitals such as inpatient psychiatric facilities and cancer hospitals.

- Number of visits
  - Hospital outpatient services
- Number of claims filed
  - Ambulatory surgical centers
  - Physician evaluation and management services
  - Physician procedures
  - Laboratory tests
  - Non-laboratory tests
  - Imaging
  - Durable medical equipment

We also generated figures for the number and percentage of beneficiaries using three other service categories: all post-acute care (comprising any use of LTCHs, IRFs, SNFs, or home health), prescription drugs covered under Part B, and other Part B services (which covers a range of services such as ambulances, chiropractors, and parenteral nutrition). We did not calculate the number of times that beneficiaries used those service categories because of the difficulty in devising a standard way to measure their utilization.

## **5. Quality measures**

The relationship between the quality and use of health care is an important element to consider when analyzing the geographic variation in Medicare utilization. For example, do areas with above-average utilization also provide high-quality care, or is there little correlation between the two?

We have added dozens of quality measures to the HIW data set to support these kinds of analyses. The measures that we have included come primarily from three different measure sets:

- Hospital Compare (HC), which was developed by CMS and uses data from hospitals and Medicare claims to measure processes and outcomes for hospital care for heart attack, heart failure, pneumonia, and surgical care.
- Prevention Quality Indicators (PQI), which is software developed by the Agency for Healthcare Research and Quality (AHRQ) that uses administrative data to measure hospital admission rates for ambulatory care sensitive conditions.
- Patient Safety Indicators (PSI), which is another AHRQ software product that uses administrative data for inpatient hospital stays to identify adverse events that occur during hospitalization.

Those measure sets have been endorsed by the National Quality Forum and are well-known to health care researchers and quality improvement organizations. The individual measures that we included are listed in Appendix 2.

The measures that we included are usually reported for an individual ZIP code or provider. We calculated them for the various regions used in the HIW data set (HRR, state, and United States) as follows:

- HC contains both process and outcomes measures. The process measures are based on a sample of each hospital's patients (both Medicare and non-Medicare); we used provider ZIP codes to identify the hospitals in each region and then calculated a weighted average for the region using each hospital's patient population for the three primary conditions measured (heart attack, heart failure, and pneumonia) as its weight.

The outcomes measures are based on each hospital's entire Medicare patient population. Those measures have underlying numerators and denominators. For example, the 30-day death rate for heart attack patients has the number of heart attack patients that died as the numerator and the total number of heart attack patients as the denominator. We added the numerators for all hospitals in a given region and divided that figure by the sum of the denominators for those hospitals to generate the measure for the entire region.

- We downloaded the PQI software from the AHRQ website and applied it to inpatient claims. The software generates results by metropolitan statistical area; we then followed procedures developed by AHRQ to convert those results to the ZIP code level. We then added the results for all ZIP codes in each region.
- PSI measures also have numerators and denominators. We downloaded the PSI software from the AHRQ website and applied it to inpatient claims. The software generates results for each individual hospital; we then used provider ZIP codes to identify all hospitals in a given region. We added the numerators for all hospitals in a region and divided that figure by the sum of the denominators for those hospitals to generate the measure for the entire region.

AHRQ's software takes the results for each PQI and PSI measure, which are usually calculated for an individual hospital, and adjusts them to reflect a nationally representative population. We believe this adjustment is inappropriate for an analysis of the older Medicare population, and so we used observed (i.e., unadjusted) rates instead. We calculated those measures separately for beneficiaries between the ages of 65 and 74 and for those who were 75 or older.

Finally, we also used the claims-level data in the CCW to calculate four metrics on hospital readmissions<sup>5</sup> and emergency room (ER)<sup>6</sup> use:

- Total number of hospital readmissions
- Hospital readmission rate (i.e., the number of readmissions divided by the total number of admissions)

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<sup>5</sup> We used all readmissions that took place within 30 days of the initial discharge.

<sup>6</sup> Our figures do not include inpatient ER visits – those that resulted in a subsequent inpatient admission – to critical access hospitals (CAHs). (Our figures do include outpatient ER visits to CAHs as well as all ER visits to PPS hospitals.) As a result, our figures underestimate ER use in areas with CAHs to some degree.

- Total number of ER visits
- Total number of ER visits per 1,000 beneficiaries



## Appendix 1 - Hospital Referral Regions

We list HRRs by state and the name of the primary city or county within each HRR. For maps that show the specific boundaries for each HRR, please go to:

<http://www.dartmouthatlas.org/downloads/methods/geogappdx.pdf>.

Alabama (6)	Birmingham, Dothan, Huntsville, Mobile, Montgomery, Tuscaloosa
Alaska (1)	Anchorage
Arizona (4)	Mesa, Phoenix, Sun City, Tucson
Arkansas (5)	Fort Smith, Jonesboro, Little Rock, Springdale, Texarkana
California (24)	Alameda County, Bakersfield, Chico, Contra Costa County, Fresno, Los Angeles, Modesto, Napa, Orange County, Palm Springs, Redding, Sacramento, Salinas, San Bernadino, San Diego, San Francisco, San Jose, San Luis Obispo, San Mateo County, Santa Barbara, Santa Cruz, Santa Rosa, Stockton, Ventura
Colorado (7)	Boulder, Colorado Springs, Denver, Fort Collins, Grand Junction, Greeley, Pueblo
Connecticut (3)	Bridgeport, Hartford, New Haven
Delaware (1)	Wilmington
District of Columbia (1)	Washington
Florida (18)	Bradenton, Clearwater, Fort Lauderdale, Fort Myers, Gainesville, Hudson, Jacksonville, Lakeland, Miami, Ocala, Orlando, Ormond Beach, Panama City, Pensacola, Sarasota, St. Petersburg, Tallahassee, Tampa
Georgia (7)	Albany, Atlanta, Augusta, Columbus, Macon, Rome, Savannah
Hawaii (1)	Honolulu
Idaho (2)	Boise, Idaho Falls
Illinois (13)	Aurora, Bloomington, Blue Island, Chicago, Elgin, Evanston, Hinsdale, Joliet, Melrose Park, Peoria, Rockford, Springfield, Urbana
Indiana (9)	Evansville, Fort Wayne, Gary, Indianapolis, Lafayette, Muncie, Munster, South Bend, Terre Haute
Iowa (8)	Cedar Rapids, Davenport, Des Moines, Dubuque, Iowa City, Mason City, Sioux City, Waterloo
Kansas (2)	Topeka, Wichita
Kentucky (5)	Covington, Lexington, Louisville, Owensboro, Paducah
Louisiana (10)	Alexandria, Baton Rouge, Houma, Lafayette, Lake Charles, Metairie, Monroe, New Orleans, Shreveport, Slidell
Maine (2)	Bangor, Portland
Maryland (3)	Baltimore, Salisbury, Takoma Park
Massachusetts (3)	Boston, Springfield, Worcester
Michigan (15)	Ann Arbor, Dearborn, Detroit, Flint, Grand Rapids, Kalamazoo, Lansing, Marquette, Muskegon, Petoskey, Pontiac, Royal Oak, Saginaw, St. Joseph, Traverse City

## Appendix 1 - Hospital Referral Regions (continued)

Minnesota (5)	Duluth, Minneapolis, Rochester, St. Cloud, St. Paul
Mississippi (6)	Gulfport, Hattiesburg, Jackson, Meridian, Oxford, Tupelo
Missouri (6)	Cape Girardeau, Columbia, Joplin, Kansas City, Springfield, St. Louis
Montana (3)	Billings, Great Falls, Missoula
Nebraska (2)	Lincoln, Omaha
Nevada (2)	Las Vegas, Reno
New Hampshire (2)	Lebanon, Manchester
New Jersey (7)	Camden, Hackensack, Morristown, New Brunswick, Newark, Paterson, Ridgewood
New York (10)	Albany, Binghamton, Bronx, Buffalo, East Long Island, Elmira, Manhattan, Rochester, Syracuse, White Plains
New Mexico (1)	Albuquerque
North Carolina (9)	Asheville, Charlotte, Durham, Greensboro, Greenville, Hickory, Raleigh, Wilmington, Winston-Salem
North Dakota (4)	Bismarck, Fargo, Grand Forks, Minot
Ohio (10)	Akron, Canton, Cincinnati, Cleveland, Columbus, Dayton, Elyria, Kettering, Toledo, Youngstown
Oklahoma (3)	Lawton, Oklahoma City, Tulsa
Oregon (5)	Bend, Eugene, Medford, Portland, Salem
Pennsylvania (15)	Allentown, Altoona, Danville, Erie, Harrisburg, Johnstown, Lancaster, Philadelphia, Pittsburgh, Reading, Sayre, Scranton, Wilkes-Barre, York
Rhode Island (1)	Providence
South Carolina (5)	Charleston, Columbia, Florence, Greenville, Spartanburg
South Dakota (2)	Rapid City, Sioux Falls
Tennessee (7)	Chattanooga, Jackson, Johnson City, Kingsport, Knoxville, Memphis, Nashville
Texas (22)	Abilene, Amarillo, Austin, Beaumont, Bryan, Corpus Christi, Dallas, El Paso, Fort Worth, Harlingen, Houston, Longview, Lubbock, McAllen, Odessa, San Angelo, San Antonio, Temple, Tyler, Victoria, Waco, Wichita Falls
Utah (3)	Ogden, Provo, Salt Lake City
Vermont (1)	Burlington
Virginia (8)	Arlington, Charlottesville, Lynchburg, Newport News, Norfolk, Richmond, Roanoke, Winchester
West Virginia (3)	Charleston, Huntington, Morgantown
Wisconsin (8)	Appleton, Green Bay, La Crosse, Madison, Marshfield, Milwaukee, Neenah, Wausau
Washington (6)	Everett, Olympia, Seattle, Spokane, Tacoma, Yakima
Wyoming (1)	Casper

## Appendix 2 – Quality Measures Included in HIW Data Set

<b>Hospital Compare (31 measures, calculated per 100 patients)</b>
Heart attack patients given aspirin at arrival
Heart attack patients prescribed aspirin at discharge
Heart attack patients given ACE inhibitor or ARB for LVSD
Heart attack patients given smoking cessation advice / counseling
Heart attack patients given beta blocker at discharge
Heart attack patients given fibrinolytic medication within 30 minutes of arrival
Heart attack patients given PCI within 90 minutes of arrival
30-day death rate for heart attack patients
Hospital 30-day readmission rate for heart attack patients
Heart failure patients given discharge instructions
Heart failure patients given an evaluation of left ventricular systolic function
Heart failure patients given ACE inhibitor or ARB for LVSD
Heart failure patients given smoking cessation advice / counseling
30-day death rate for heart failure patients
Hospital 30-day readmission rate for heart failure patients
Pneumonia patients given oxygenation assessment
Pneumonia patients assessed and given pneumococcal vaccination
Pneumonia patients with initial ER blood culture performed prior to initial antibiotic in hospital
Pneumonia patients given smoking cessation advice / counseling
Pneumonia patients given initial antibiotic(s) within 6 hours of arrival
Pneumonia patients given the most appropriate initial antibiotic(s)
Pneumonia patients assessed and given influenza vaccination
30-day death rate for pneumonia patients
Hospital 30-day readmission rate for pneumonia patients
Surgery patients received preventative antibiotic(s) 1 hour before incision
Surgery patients received the appropriate preventative antibiotic(s) for their surgery
Surgery patients had preventative antibiotic(s) stopped within 24 hours after surgery
Cardiac surgery patients with controlled 6 AM postoperative blood glucose
Surgery patients with appropriate hair removal
Surgery patients whose doctors ordered VTE for certain types of surgeries
Surgery patients who received appropriate VTE within 24 hours before or after certain surgeries
<b>Prevention Quality Indicators (12 measures, calculated per 100,000 beneficiaries)</b>
Diabetes short-term complications admission rate
Diabetes long-term complications admission rate
Chronic obstructive pulmonary disease admission rate
Hypertension admission rate
Congestive heart failure admission rate

## Appendix 2 – Quality Measures Included in HIW Data Set, continued

<b>Prevention Quality Indicators, continued</b>
Dehydration admission rate
Bacterial pneumonia admission rate
Urinary tract infection admission rate
Angina without procedure admission rate
Uncontrolled diabetes admission rate
Adult asthma admission rate
Rate of lower extremity amputations among patients with diabetes
<b>Patient Safety Indicators (6 measures, calculated per 100,000 beneficiaries)</b>
Pressure ulcer
Iatrogenic pneumothorax
Central venous catheter-related bloodstream infections
Postoperative pulmonary embolism or deep vein thrombosis
Postoperative sepsis
Accidental puncture and laceration
<b>Readmissions and Emergency Room Use (4 measures)</b>
Total number of hospital readmissions
Hospital readmission rate
Total number of emergency room visits
Total number of emergency room visits per 1,000 beneficiaries
<b>Abbreviations:</b> ACE = angiotensin-converting enzyme, ARB = angiotensin receptor blocker, DRG = diagnosis-related group, ER = emergency room, LVSD = left ventricular systolic dysfunction, PCI = percutaneous coronary intervention, VTE = venous thromboembolism